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Towards constructing the governable worker in nineteenth-century Britain

ABSTRACT

The governable worker, in Britain, is defined by the existing literature as a creation of the scientific management movement of the early twentieth century and, within the accounting domain, through standard costing as a disciplinary practice. This paper studies actions taken by the administrators and managers of Britain's government military manufacturing establishments (GMMEs), from the 1850s onwards, to create a more governable workforce. This objective was achieved through the imposition of disciplinary practices, most importantly the use of time records to ensure attendance at the workplace and expert knowledge-based piece rates to monitor and control labour intensity. The absence of scientifically-established labour standards at GMMEs is acknowledged but, in other important respects, accounting is shown to have played a key role in the formulation of disciplinary practices designed to construct a governable labour force some decades before standard costing became the mechanism for rendering visible efficiency within the workplace.

Keywords: Accounting; Foucault; governable worker; piece rates.

1. Introduction

Prime Minister Margaret Thatcher's first administration (1979-1984) was committed to improving the public finances through the elimination of wasteful and unnecessary expenditure and the pursuit of efficiency savings. A fundamental problem which needed to be overcome to create a 'lean and more competitive' public sector capable of supplying its citizens with greater value for money was the perceived lack of managerialism (Groot & Budding, 2008, p. 2). The phenomenon which became known as New Public Management (NPM) was 'strongly related to the adoption of business-like management and accounting instruments' (van Helden, 2005, p. 9) and, in the years that followed, corresponding accounting reforms were introduced in many other countries (Christiaens & van Petegham, 2007, p. 375).

Nineteenth century British government witnessed an earlier emergent interest in the pursuit of efficiency and economy in the conduct of public affairs. Leading politicians such as Joseph Hume, Sir Henry Parnell and Sir James Graham were influential advocates of improved productivity. Hume as the leader of the radical party in Parliament has been described as 'the self-elected guardian of the public purse' and credited with causing the word 'retrenchment' to be added to the radical party's agenda of 'peace and reform' (*Encyclopaedia Britannica,* 1910, p. 884). Parnell was an indefatigable critic of excessive government expenditure both in Parliament and in a

series of publications, the most influential of which was *On Financial Reform* (Parnell, 1830). Graham, as First Lord of the Admiralty and overlord of the main spending departments, was in a position to employ his 'brilliant administrative talents' to help put these ideas into action (Ward, 1967: xv).

More broadly, the changing composition of Parliament was important in transforming attitudes towards public expenditure. During the second quarter of the nineteenth century the landed aristocracy came under increasing challenge from the commercial and industrial classes for control over the nation's affairs. Perkin (1969, p. 272) sums things up as follows:

> neither contemporaries nor historians have doubted that the capitalist middle class were the 'real' rulers of mid-Victorian England, in the sense that the laws which were passed and executed by landed Parliaments and Governments were increasingly those demanded by the business men.

The policy objective of such 'business men' was to pursue 'cheap and efficient government' as part of the endeavour to create a 'society based on capital and competition' (Perkin, 1969, p. 320). The concern to achieve full value for public expenditure featured prominently in the deliberations of government-appointed committees whose work is recognised in this paper with, for example, the terms of reference of the Select Committee on Military Organization (BPP 1860 (441), p. iii, emphasis added) comprising the obligation 'to inquire whether any Changes are required to secure the utmost *Efficiency and Economy* in the Administration of Military Affairs'. The introduction of the commercial system of double entry to supply a better system of financial control and accountability in response to these concerns is well documented (Edwards & Greener, 2003; Funnell et al., 2016). This paper focuses on the use of new ways of accounting to help minimise production costs in the British government's military manufacturing establishments (GMMEs).

Consistent with the nineteenth-century political philosophy of laissez-faire, however, many influential politicians and bureaucrats believed that the manufacture of armaments should best be left to the 'private trade' as revealed, for example, in the House of Commons debate on 'Government Manufacturing Establishments' on 22 July 1864 (Hansard, vol. 176, cols 1907-1977). British industrialists were also, of course, keen to maintain such an arrangement. The case for the government taking a degree of control over weapon manufacture came from military personnel on grounds of cost and reliability of supply (Edwards, 2015, pp. 418-420). The initial, compromise solution was

to employ both sources of supply with the GMMEs weaponry costs of production also serving as 'a check upon the price of contractors' (BPP 1854 (236), p. x).

The senior managers of GMMEs were invariably military men, and their preference for the in-house supply of armaments provided a clear incentive to drive down production costs and develop reporting practices which showed them to be least-cost suppliers of weaponry required by the state (Edwards, 2015).[1] In 1858, for example, the Superintendent of the Royal Small Arms Factory [RSAF] at Enfield Lock, Colonel William Manley Hall Dixon, and its chief engineer, James Henry Burton,[2] devised a financial report for presentation to Parliament which showed 'profit' as 'the difference between the cost price of the Arms [manufactured at the RSAF] and the price at which they could be purchased from the Trade' (Burton Papers, 1858, February 24). Dixon informed the 1860 Select Committee on Military Organization that 'a saving to the Government of 93,920*l.* 14*s*. 5*d*' had been made 'as contrasted with the present price of the same rifle made in the trade' at Birmingham and London (BPP 1860 (441), q. 5538). It subsequently became standard practice to make annual returns to parliament which (i) provided a detailed build-up of the unit cost of every item manufactured at GMMEs, and (ii) revealed savings on armaments which could, alternatively, be acquired from the business sector (e.g. BPP 1864 (392), pp. 73-74, p. 76).

These financial reports were not used, however, to manage the labour force, and the research question addressed in this study is the extent to which the administrators and managers of Britain's GMMEs created a governable workforce through the imposition of

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[1] Concern with the efficiency and effectiveness of the government's operations was by no means confined to GMMEs. Sir Charles Trevelyan, who (with Stafford Northcote) is famous for advocating the introduction of competitive examinations as the meritocratic basis for admission to the civil services, wrote to the Chancellor of the Exchequer, W.E. Gladstone in 1854, urging radical reform of the civil service designed to make 'the Treasury really a *supervising* Office, possessed of a firm hold of all the branches of business which it had to deal with' (Trevelyan to Gladstone, quoted in Hughes, 1949, p. 55). As Trevelyan put it in 1850, his aim was that the working of departments should be watched over by the Treasury 'as a master-manufacturer watches his machinery' (BPP 1854-1855 (1870), p. 433).

[2] Burton was recruited from Harpers Ferry, Virginia, to manage the installation and operation at the RSAF of machinery acquired from the United States (Lewis, 1996, p. 23, p. 340; Tate 2006, pp. 106-107). As shown in section 3, below, mass production and assembly-line techniques were disseminated from American to Britain around this time and this naturally resulted in the movement of skilled personnel between the two countries.

a range of disciplinary procedures as theorised by Michel Foucault (see section 2). We will see that the catalyst for the introduction of procedures capable of achieving better control over labour was changes in workplace practices associated with adoption of a technological phenomenon known as 'the American system of manufacturing'[3] (Chandler, 1977, p. 75) developed at the Springfield Armory, Massachusetts and Harpers Ferry, Virginia during the first half of the nineteenth century.[4] Hoskin and Macve (1988) attribute the genesis of managerialism, based on the use of accounting to achieve more intensive utilisation of the workforce, to a series of events at the former of these two government armories in the 1830s and 1840s. In Britain, corresponding arrangements awaited the scientific management era, with the premium and piece-rate arrangements operated at Boulton & Watt from about 1795 onwards dismissed by Fleischman, Hoskin and Macve (1995, p. 171, p. 174; cf. Toms & Fleischman, 2015) as an imprecise, 'one-off' exercise. This paper will show, however, that the formulation of piece rates based on careful empirical study was instrumental in achieving, within GMMEs, more intensive utilisation of the labour force from the middle of the nineteenth century onwards. As a result, management assumed a greater degree of direct responsibility for controlling the labour force though not, perhaps, in the overtly 'scientific' and intrusive fashion associated with Taylorism (Kanigel, 1997).

The GMMEs studied in this paper comprise the RSAF at Enfield Lock, the Royal Gunpowder Factory, Waltham Abbey and the following three establishments located at the Royal Arsenal in Woolwich: the Royal Laboratory; the Royal Carriage Department; and the Royal Gun Factory. The time-frame covered by this paper is 1851, when the Great Exhibition provided a forum which brought to the attention of the British public major American advances in production technology, and 1887 when evidence presented to the Committee Appointed to Inquire into the Organization and Administration of the Manufacturing Departments of the Army clarified the extent to which GMMEs employed piece-rate accounting to help construct a more governable person. The GMMEs undertook substantial manufacturing operations with Table 1

[3] This term contrasts with the earlier English system of manufacturing discussed in section 4.

[4] Paradoxically features of this system were devised by Marc Isambard Brunel (father of the even more famous Isambard Kingdom Brunel) for the manufacture of pulley blocks at the Portsmouth dockyards in about 1803 (Lewis 1996, p. 19; see also p. 311). Whether any debt is owed to Brunel from American engineers is unclear.

providing employment and expenditure statistics for each of them for the accounting years 1870-1871 and 1885-1886. Further signals of the size of their operations are provided by the knowledge that output in 1885-1886 included 59,930 rifles at the RSAF, 383 rifled muzzle-loading and breech-loading heavy guns at the Royal Gun Factory, and 60,953,739 cartridges at the Royal Laboratory (BPP 1887 (254), pp. 69-70, p. 120, p. 150, p. 164).

Table 1.
Employment and expenditure statistics for GMMEs (BPP 1887 (C.5116), pp. 623-625).

Year	Average no. employed	Wages (£)[5]	Total departmental expenditure (£)
Royal Small Arms Factory Enfield Lock			
1870-1871	2,110	189,022	258,541
1885-1886	2,079	197,086	286,082
Royal Gunpowder Factory Waltham Abbey			
1870-1871	157	10,552	18,013
1885-1886	374	26,939	81,361
Royal Carriage Department Woolwich			
1870-1871	1,382	111,034	148,309
1885-1886	2,061	221,262	388,681
Royal Gun Factory Woolwich			
1870-1871	903	79,871	203,984
1885-1886	1,834	192,932	453,054
Royal Laboratory Woolwich			
1870-1871	2,674	152,683	309,763
1885-1886	5,694	451,454	922,326

The principal primary resources used to conduct this study are House of Commons Parliamentary Papers[6] which are available electronically[7] and comprise thousands of files that can be interrogated employing keywords relevant to the research question under investigation. Of particular importance is evidence taken before government committees which supplies a record of what accounting practices were followed and why they had been (or should be) adopted. Further, the examination and cross-

[5] £ s. d. are abbreviations for the words pounds (sterling), shillings and pence which described the pre-decimalisation (15 February 1971) currency in Britain. There were 12 'old' pence (d.) in a shilling (s.) and 20 shillings in a pound (£).
[6] So far as I am aware none of the relevant accounting records of GMMEs have survived from the period studied in this paper.
[7] Chadwyck Healey's collection of House of Commons Parliamentary Papers can be accessed at: http://parlipapers.chadwyck.co.uk.

examination of witnesses[8] reveals insights to the mentalities behind choices made that, typically, are absent from the surviving archives of businesses operating in the private sector. A limitation of this study is the unavoidable reliance on official sources which produces the risk of a history reflecting the views of the 'dominant group' (Hammond & Streeter, 1994, p. 272), i.e. the opinions of civil servants associated with GMMEs and the various layers of management within those institutions, rather than the rank and file working at those locations. The 'new accounting history' has given a stronger voice, often through oral history studies, to individuals and groups that more traditional histories are inclined to overlook. Such a possibility is unavailable for studies located prior to existing living memory, as is the case here.

The remainder of this paper is structured as follows. The notion of the governable worker as the conceptual guidance for this paper is first explained. Next, the study is contextualised by (i) examining the transfer to the RSAF at Enfield Lock of a technological phenomenon labelled 'the American system of manufacturing' (Chandler, 1977, p. 75), and (ii) studying the widespread use of piece-rate based remuneration in Britain and, latterly, its role in the transition from 'extensive' to 'intensive' utilisation of the workforce (Hobsbawm, 1964, p. 356). The construction of a system of expert knowledge-based piece rates designed to create a governable workforce within Britain's GMMEs is next studied. This is followed by a review of the accounting procedures employed to better depict human visibility in written form, and the further cost-cutting initiatives mounted to address the government's growing concern with efficiency and economy within the public domain. Concluding remarks are then presented.

2. The governable worker

The theoretical lens for viewing events at GMMEs in the second half of the nineteenth century is provided by Michel Foucault's *Discipline and punish*[9] wherein he explains how

[8] The government committees whose work is studied in this paper might be composed entirely of members of parliament (i.e. a select committee) or might include people from outside Westminster with expert knowledge of the issues under investigation. The members of the committees (usually about a dozen) then decided which people (e.g. managers of GMMEs) might help them answer their remit. Such 'witnesses' would be asked for their views and opinions on particular issues and were the subject of interrogation designed to investigate further the validity of their evidence.

[9] Originally published in 1975, the English-language edition translated by Alan Sheridan and issued by Penguin Books in 1991 is cited here.

disciplinary power achieves 'the submission of bodies through the control of ideas' (Foucault, 1991, p. 102). That is, it transforms undisciplined and independently minded individuals (e.g. soldiers, prisoners and workers) into 'docile bodies' that can be managed and improved (Foucault, 1991, p. 135). *Discipline and punish*, despite its subtitle *The birth of the prison,* is not a study of the management of a particular institution but of the nature and operation of a disciplinary technology. Foucault's theory of the emergence of a disciplinary society 'has been rehearsed many times in the accounting literature' (Walker, 2010, p. 630) and, in this section, it is sufficient to recount key tenets of *Discipline and punish* to provide a framework for the study of piece work arrangements at Britain's GMMEs before moving on to review accounting history literature that exploits his ideas.

Discipline and punish

The first point to make, and it is one which is pertinent in the context of the present study, is that Foucault's theory of disciplinary power focuses on the individual not the group: 'Instead of bending all its subjects into a single uniform mass, [disciplinary power] separates, analyses, differentiates, carries its procedures of decomposition to the point of necessary and sufficient single units' (Foucault, 1991, p. 170). But while Foucault (1991, p. 187) insists that 'It is the fact of being constantly seen, of being able always to be seen, that maintains the disciplined individual in his subjection', such individuals are not necessarily expected to play an entirely passive role in the exercise of disciplinary power. Instead, it is a 'form of power [that] augmented human capacities rather than repressed them' (Armstrong, 1994, p. 28). Further, each person is an active participant in reinventing himself: 'Discipline "makes" individuals; it is the specific technique of a power that regards individuals both as objects and as instruments of its exercise' (Foucault, 1991, p. 170). This paper nevertheless reveals evidence of friction between the managers and those managed in the pursuit of greater efficiency within the workplace.

The success of disciplinary power in creating the governable person is attributed to the 'use of simple instruments; hierarchical observation, normalizing judgement and their combination in a procedure that is specific to it, the examination' (Foucault, 1991, p. 170). Hierarchical observation consists of 'an apparatus in which the techniques that make it possible to see induce effects of power' and transform behaviour (Foucault,

1991, p. 171). Such apparatus might be architectural and 'act on those it shelters, to provide a hold on their conduct, to carry the effect of power right to them, to make it possible to know them, to alter them' (Foucault, 1991, p. 172). Here Foucault cites the architecture of the Oberkampf manufactory at Jouy-en-Josas, constructed in 1791 (i.e. at the naissance of the disciplinary era), as an excellent example of the creation of disciplinary space. Features of construction designed to facilitate the 'disciplinary gaze' of factory supervisors included: a building 110 metres long and three stories high; production arranged in two parallel rows running the length of the building; and successive stages of production grouped together. Consequently, by 'walking up and down the central aisle of the workshop, it was possible to carry out supervision that was both general and individual' (Foucault, 1991, p. 145). There is no discussion of the presence of written records at Oberkampf but, quite clearly, supervisors could 'observe the workers presence and application, and the quality of his work; to compare workers with one another; to classify them according to skill and speed' (Foucault, 1991, p. 145).

On the need to move beyond the architectural to engage with non-visual forms of surveillance, Foucault again turns briefly away from the prisons, workhouses, hospitals and schools that are the principal foci of his work (Grey, 1994; Walker, 2010, p. 638). The need for a new way of creating visibility is acknowledged by Foucault (1991, p. 174) as 'the problem of the workshops and factories in which a new type of surveillance was organized'. There, he recognises that, as 'the machinery of production became larger and more complex, as the number of workers and the division of labour increased, supervision became ever more necessary and difficult' (Foucault, 1991, p. 174). The need for 'an intense, continuous supervision' of the labour process, which 'took into account the activity of the men, their skill, the way they set about their tasks, their promptness, their zeal, their behaviour' was supplied by a phalanx of 'clerks, supervisors and foremen' (Foucault, 1991, p. 174). Foucault goes into no detail about how this was to be achieved within workshops and factories but, of course, there was no need for him to do so. His main focus was elsewhere, but the above comments make clear the fact that the basic principles expounded in *Discipline and punish* were intended for general application.

Different forms of surveillance – both direct and indirect –therefore provide the basis for Foucault's normalizing judgements but it is the latter – the depiction of human selves in written form – that is the major focus of *Discipline and punish*. There,

disciplinary power 'brings five quite distinct operations into play: it refers individual actions to a whole that is at once a field of comparison, a space of differentiation and the principle of a rule to be followed. … In short, it *normalizes*' (Foucault, 1991, pp. 182-183). Foucault's work does not focus upon accountancy *per se*, but he does engage with the language of the accountant when discussing the measurement of performance (Walker, 2010, p. 630). On the range of numerical observations that might be collected with the aim of normalising behaviour, Foucault (1991, p. 180) comments: 'Moreover, it is possible to quantify this field and work out an arithmetical economy based on it. A penal accountancy, constantly brought up to date, makes it possible to obtain the punitive balance-sheet of each individual'. The basis for normalising judgements is therefore provided by the examination which places individuals in a field of surveillance [and] also situates them in a network of writing; it engages them in a whole mass of documents that capture and fix them' (Foucault, 1991, p. 189). The examination therefore provides a different and, around 1800, a new type of visibility of the actions of an observed population though, importantly, obtained through invisible means.

The 'penal accountancy' identifies deviations from the norm and, where negative, 'Disciplinary punishment' is designed to reduce gaps and fulfil an 'essentially *corrective*' function (Foucault, 1991, p. 179). But 'Disciplinary punishment is, in the main, isomorphic with obligation itself; it is not so much the vengeance of an outraged law', as exercised in the era of sovereign power, and 'the corrective effect expected of it involves only incidentally expiation and repentance; it is obtained directly through the mechanics of training. To punish is to exercise' (Foucault, 1991, p. 179). Punishment, whatever form it takes, is not an end in itself. Its purpose is to encourage compliance and, for this reason, there was put in place a system of rewards as well as punishment.

These, then, are the themes which frame this study of workplace and accounting practices introduced at Britain's GMMEs during the second half of the nineteenth century. Given the well-known independent-mindedness of factory Superintendents – all military men – who ran each of the five institutions as if their own personal fiefdoms, and the fact that quite different instruments of warfare were manufactured at each location, organisational arrangements differed a great deal. We nevertheless find ample evidence of steps taken to ensure that workers were 'constantly seen' by management through both direct observation and measurement practices. It will also become evident that the piece rates fulfilled a dual function by bestowing financial reward on the

disciplined worker and punishment, through lower wages, on those whose output fell below expected norms. It is also argued that expert knowledge-based piece rates fulfilled a 'corrective' role in the creation of 'docile bodies' and that workers, through observation of how they and their colleagues were treated, participated in their own subjugation. It will also be revealed, however, that the actions of workers did not always display passive submission to the demands placed upon them by the dominant group. In particular, we will see that GMME workers indulged in game-playing designed to challenge the piece-rate as an effective disciplinary mechanism.

The arrangements put in place at Britain's GMMEs in the endeavour to create 'docile bodies' (Foucault, 1991, p. 135) which could be managed and improved are studied in sections 3-6. First, however, important case studies of the way in which Foucault's ideas have already been exploited to theorise labour management practices are reviewed.

Foucault in accounting history

An early issue of *Critical Perspectives on Accounting* states that Foucault's theories 'have had a profound effect on science, and accounting thought in particular' (Cooper & Tinker, 1994, p. 1). In the accounting arena Cooper and Tinker reflect on a spate of articles, beginning in the early 1980s, which drew on Foucault's ideas and those of other postmodern philosophers 'to situate accounting in the world of lived experience as both a product of social construction and as an architect of social experience' (Neimark, 1990, p. 106). As Armstrong (1994, p. 26) predicted, Foucauldian theories have since continued to provide inspiration for much academic research.

Foucault's disciplinary technology gained a degree of adoption in the eighteenth century and was applied 'with a vengeance' to institutions in the nineteenth century (Dreyfus & Rainbow, 1986, p. 153). Research has revealed accounting in a range of disparate guises as an apparatus 'imbued with aspirations for the shaping of conduct in the hope of producing certain desired effects' (Rose, 1990, p. 52). Confining attention to the subject of the present paper, i.e. the business world, there are a number of prior contributions to the literature which employ a Foucauldian framework to help understand how accounting, as a disciplinary technique which renders the actions of workers visible and calculable, succeeds in changing their behaviour to better achieve managerial objectives. Four publications, in particular (Carmona et al., 2002; Walsh & Stewart, 1993; Miller & O'Leary 1987; Hoskin & Macve, 1988), serve as helpful sources

for understanding the purpose, contribution and limitations of the present study. They focus on the use of accounting to govern the behaviour of factory workers in three different countries – Spain, the United States and Britain. It should be made clear that the purpose of this paper is not to rank the Spanish Royal Tobacco Factory, the Springfield Armory, the New Lanark Cotton Factory and Britain's GMMEs in terms of whether arrangements fully reflect the Foucauldian concept of disciplinary power. Equally there is no concern here to judge which of the arrangements was most successful in achieving effective management of the labour force. The prior literature is important because it shows that at different times and in different places the procedures articulated and theorised by Foucault emerged as part of the endeavour to create a more docile, manageable and efficient workforce.

The Spanish Royal Tobacco Factory has proved a particularly fruitful site for the study of accounting as a disciplinary practice, Carmona et al. (2002) examine new arrangements put in place when the city of Seville moved the production of tobacco from the San Pedro Factory to the New Factories in 1758. They show how 'the intertwining of accounting and spatial practices provide discipline in the factory by yielding calculable spaces and accountable subjects' (Carmona et al., 2002, p. 239). Central to their story is the creation of 'docile bodies' through the demarcation of space based on 'enclosure, partitioning, coding and the rank' (Carmona et al., 2002, p. 243). Fúnez' (2005) further studies the disciplinary character of the accounting practices adopted at the Royal Tobacco Factory with a specific focus on the period 1761 to 1790.

A pioneering application of Foucault's ideas in the endeavour to gain a better understanding of factory-based management is Hoskin and Macve's (1988) study of events at the Springfield Armory, Massachusetts in the second quarter of the nineteenth century. It is a paper that should also be introduced at this stage because, as we shall see, certain production and work practices employed at the Springfield Armory were transmitted to Britain's GMMEs in the 1850s. Hoskin and Macve (1988) believe that they locate the genesis of managerialism at the Springfield Armory, and they attribute this breakthrough to the work of the Army Inspector of Contract Arms, Daniel Tyler. It was Tyler who, in their estimation, made calculable the performance of individual workers based on time and motion studies undertaken 'watch in hand' over a six month period in 1831-1832 (Hoskin, 2004, p. 747). This enabled Tyler 'to impose a new way of seeing each individual worker in terms of norms and deviations from the norm'

(Ezzamel et al., 1990, p. 159) and, as a result, the power of disciplinarity penetrated the workplace in a manner which created 'both financial and human accountability' (Hoskin & Macve, 1988, p. 43).[10]

Turning to British accounting history, Walsh and Stewart (1993) studied the accounting records at two sites separated by about a century – the New Mills Woollen Manufactory 1681-1703 and the New Lanark Cotton Factory 1800-1812 – to adduce evidence of the changing role of accounting for labour. They discern remarkable differences. At New Mills, where 'Customary rates were paid to piece workers' (Walsh & Stewart, 1993, p. 785), they see accounting confined to a record of market transactions. At New Lanark, however, they detect a 'very different notion of government' which 'embrace[d] a series of techniques of inspection' that enabled management to modify behaviour through knowledge (Walsh & Stewart, 1993, p. 787, p. 789).

Moving forward in time a 100 or so years, Miller and O'Leary (1987) locate the creation of the governable worker, in Britain, as part of the scientific management movement, often referred to as Taylorism.[11] Miller and O'Leary (1987, p. 241) reveal how standard costing, as part of the quest for scientific management that gained momentum during the first three decades of the twentieth century, took cost accounting to a new level by rendering visible the efficiencies of individuals within an enterprise.

The present paper is temporally located midway between the latter two British-based studies. The degree of governability through accounting detected at Britain's GMMEs, commencing in the 1850s, is certainly less intrusive than that which Miller and O'Leary (1987) show to have emerged in the era of scientific management. Nevertheless, it will be revealed that the system of piece-rate accounting introduced at GMMEs rendered 'visible', through the use of norms (the hourly rate) and standards (the piece rate), as with standard costing, 'certain crucial aspects of the functioning' of these enterprises (Miller & O'Leary, 1987, p. 239). The conclusion reached, therefore, is that an important episode in the creation of a governable worker in Britain remained unrecognised when Miller and O'Leary (1987, p. 239) claimed that '[i]n the nineteenth

[10] The extent to which Tyler's innovations represented a major discontinuity in labour management has been challenged by Tyson (1993).

[11] The term scientific management was coined by Louis Brandeis when presenting evidence before the US Interstate Commerce Commission in 1910. Frederick Winslow Taylor, who had previously used the term 'shop management', titled his 1911 text: *The principles of scientific management*.

century discipline within the enterprise took the form of direct confrontations between the worker and the boss'. However, as in the case of standard costing systems, we will see that skirmishes arose when establishing and revising norms and standards of performance.

The present paper therefore broadens our understanding of the construction of the governable worker in Britain through a system of factory surveillance that ranged from the architectural and organizational to new ways of doing accounting through the use of detailed time records and carefully-constructed piece rates to monitor and control labour intensity. As with the system of standard costing that grew out of the scientific management movement, this paper will reveal the use of accounting records, in addition to direct observation, as the basis for management surveillance of the workforce and, thereby, the movement towards 'managing by the numbers' (Geneen & Moscow, 1984; Ezzamel et al., 1990, p. 161). As with Walsh and Stewart (1987, p. 784) 'Our main argument is that accounting was intertwined with the emergence of the factory rather than a neutral technique awaiting changes in user needs which were correlated with the Industrial Revolution'.

The next two sections locate this study within its time-specific historical context. The first charts the events which led to the introduction, at the RSAF in the 1850s, of a technological phenomenon known as the 'American system of manufacturing' (Chandler, 1977, p. 75).

3. Mass production and Assembly-line techniques

In a 60-year period commencing 1839 the United States share of world manufacturing output rose from 17 per cent to 53 per cent (Gallman, 1960, p. 26). An important driver for this astounding growth-rate was the so-called 'American system of manufacturing'. The mass production of large numbers of standardised goods, such as textile products, was a feature of the early days of the British industrial revolution. The 'American system of manufacturing', which enabled the mass production of goods by employing largely unskilled labour working with standardized designs, self-acting machinery and assembly-line techniques, was something entirely different.

The potential of the new system was brought to the attention of the British public at the Great Exhibition held in Hyde Park in 1851. The purpose of the Exhibition was to enable British industrialists to show off their wares to the world and to serve as 'a

visible expression of the country's economic might' (Daunton, 2000, p. 73). It is therefore ironic that the exhibition also provided a platform for US manufacturers to startle '[l]eading English engineers and military men' with products, particularly guns, which reflected engagement with 'revolutionary production methods' (Best, 1990, p. 30). Samuel Colt, proprietor of the US-based Patent Arms Manufacturing Company, astounded the audience when he 'put his revolvers on display and demonstrated the interchangeability of parts by dissembling a number of pistols, jumbling the parts and then reassembling them into workable revolvers once again' (McNeill, 1982, pp. 233-234; see also Rosenberg, 1969, pp. 15-18). Perhaps encouraged by this interest, Colt opened a factory on the River Thames at Pimlico. A fact-finding visit to Colt's factory made an indelible impression on Lieutenant Colonel Tulloh, Inspector of the Royal Carriage Department:

> it was something so different from anything I expected, and so beautiful … The consecutive arrangements of the machinery were such as I have never seen in any department before. There were, I think, about 150 machines at work, and those machines were all placed in a kind of consecutive arrangement to produce a pistol … It seemed to be a kind of stream of work flowing through the manufactory in consecutive order (BPP 1854 (236), q. 413).

Colt's machine-intensive manufacturing process, in contrast with the handicraft methods still practised by British gunmakers in their small workshops, required production to be broken down into its constituent elements. This yielded a range of important benefits that included reduced reliance on skilled labour, increased precision, and interchangeable parts.[12] This latter virtue was of particular interest to militarists as it meant that an army could go into battle with a store of suitable spares rather than having to rely on the availability, in the field, of skilled workmen to repair damaged guns and artillery (Rosenberg, 1969, pp. 46-47).

Impressed by these possibilities, and citing the unreliability of the private trade as a supplier of weaponry, the Board of Ordnance gained permission to 'erect a Government establishment capable of producing muskets in large numbers, and at a moderate price, by the introduction of machinery into every part of the manufacture where it was applicable' (BPP 1854-1855 (0.11), p. 1). A Committee on the Machinery of the United States was set up with the authority to purchase appropriate equipment. The

[12] Interchangeable parts are components made to strict specifications so that they are nearly identical and will fit into any assembled product, e.g. a rifle, of the same type.

Committee visited a number of the 'best Government and private establishments' including the Springfield Armory and Sharpe's Rifle Manufacturing Company, Hartford. It was provided with every facility to carry out its work. At Springfield, for example, Superintendent Colonel Ripley gave them full access to information concerning the Armory' operations, while one of its clerks, a Mr Allen, made available 'a number of valuable papers describing the method on which book-keeping, &c., was there conducted' (BPP 1854-1855 (0.11), p. 22).

The radical character of innovations subsequently introduced at the RSAF in the late-1850s can best be appreciated in contrast to the prevailing manufacturing arrangements within the craft engineering workshops[13] of the private sector, which themselves reflected the wider industrial scene as described by Daunton (2000, p. 74): 'The industrial economy of nineteenth-century Britain was highly fragmented, dominated by small units in the hands of families and partnerships, with a low level of integration between different stages of production'.

The introduction of the American-style techniques of mass production at the RSAF required complete reorganisation of the gun making facility in a newly-constructed machine shop (Fig. 1). This included 'one large room' of 180 feet by 500 feet (Pam, 1998, p. 47) where machinery was aligned in a series of neat rows (Fig. 2) so as

> to have everything connected with it [production] passing consecutively on from one stage to another, never passing over the same ground twice, so that the raw materials which go in at one side shall come out a finished musket at the other (Anderson, BPP 1854 (236), q. 348).

The significance of these arrangements for the creation of 'docile bodies' in a Foucauldian sense is next considered.

3.1. Docile bodies

The creation of docile bodies involves 'the art of distributions' whereby, according to Foucault (1991, p. 141), 'discipline proceeds from the distribution of individuals in space', with a range of techniques employed to achieve that outcome (Carmona et al., 2002, p. 243). First there is often the need for *enclosure* which, for production purposes, comprises 'great manufacturing spaces, both homogeneous and well defined' (Foucault,

[13] A factory (in contrast to a domestic) workshop was typically a room or small establishment where individuals employed hand-based (handicraft) skills to produce a particular article using tools made available for their use

1991, p. 142) with, for example, the Royal Arsenal exemplifying this condition through occupation of a secure area adjacent to the south bank of the River Thames in Woolwich which was accessed through the Beresford Gate built in 1828. The creation of an enclosed space of this character was designed 'to protect materials and tools and to master [i.e. discipline] the labour force' (Foucault, 1991, p. 142). To make enclosure an effective disciplinary instrument, a system of *partitioning* is required so that 'each individual has his own place; and each place its individual' (Foucault, 1991, p. 143). The replacement of workshops, where groups of individuals cooperated in an informal manner to produce a product, by assembly line techniques, where each individual is charged with responsibility for performing a clearly identifiable function, enables the imposition of discipline based on a created, analytical space.

The third element in the art of distributions is the construction of functional sites: 'The rule of *functional sites* would gradually, in the disciplinary institutions, code a space that architecture generally left at the disposal of several different uses' (Foucault, 1991, p. 143). In the case of factories, this required the distribution of individuals to 'a space in which one might isolate and map them' (Foucault, 1991, p. 144). What Foucault terms 'useful' spaces were therefore constructed for purposes of supervision, measurement and control. Fourthly, there is the concept of rank whose significance (Foucault, 1991, p. 145) emerges from the fact that 'In discipline, the elements are interchangeable, since each is defined by the place it occupies in a series, and by the gap that separates it from others'. Foucault discusses this concept of rank principally in the context of performance in the classroom based on marks achieved, but the use of expert knowledge-based piece rates as a disciplinary technology for purposes of supervision and reward follows the same principles. The creation of docile bodies is therefore based on a complex array of socially constructed practices which enable constant surveillance of performance in the workplace.

One might reasonably imagine that workplace arrangements and practices central to the thinking of GMMEs managers, as epitomised by the design and construction of the RSAF's machine shop, supplied supervisors with the kind of disciplinary gaze that Foucault associated with the Oberkampf factory built just south of Paris over 60 years earlier. Certainly this appears to have been the intention of the Board of Ordnance when instructions for the construction of the machine shop were issued. These insisted, as a first priority, that the machine shop should be designed 'on those principles by which

the greatest economy *and easiest supervision of labour* are secured' (1854 (236), q. 418, emphasis added). Fig. 2 reveals that the assembly line was not however automated, so that 'the time taken for any particular job was governed by the speed of the worker' (Pam, 1998, p. 58). Thus the labour force was not yet subordinated to the 'yoke of the machine' (Braverman, 1974, p. 231) and management instead relied on piece-rate based remuneration to provide the incentive for employees to work as quickly as possible.

The division of manufacturing activities into a series of identifiable tasks is particularly well-suited to payment by the 'piece', and the next section reviews the role of piece-rate based remuneration to discipline and achieve intensive utilisation of the GMMEs workforce.

4. Piece rates, discipline and the control of labour

The piece-rate method of worker remuneration was used in Britain as early as the 15th century, and it flourished during the 17th and 18th centuries. Under the so-called domestic system, the piece of work, e.g. a woman spinning yarn, was performed in the home on behalf of the merchant capitalist who supplied the materials. As far as the merchant capitalist was concerned it did not matter how quickly or flawlessly the work was done. For example, the textile merchant paid an agreed price for each yard of yarn only when complete and conforming to quality requirements. It was also a convenient arrangement for the worker: the mother spinning yarn in the home was able to look after her children while, perhaps, her partner laboured in the fields.

A new way of organising production known as the English system of manufacturing was created during the industrial revolution. By bringing workers together in a factory they could become the subject of supervision, thereby enabling the capitalist to achieve, in theory, 'control of [the rate of] production as well as control of the [quality of the] product' (Jones, 1995, p. 16). This potential for some time remained unfulfilled, perhaps due to managerial shortcomings and certainly because the workforce was '[un]attuned to the levels of speed, regularity and direct supervision' which the pursuit of increased governability entailed (Wilson, 1995, p. 32), i.e. workers were simply not yet amenable to a regime of disciplinarity in the Foucauldian sense. To minimise friction between management and worker a type of piece-rate remuneration called 'sub-contracting' or 'inside contracting' was devised. The sub-contractor or piece-master was paid an agreed sum of money for a pre-arranged quantity of completed goods. The piece-master's profit

was the difference between the agreed lump sum and the amount paid to members of his team. This was an arrangement that transferred managerial responsibilities from the capitalist to the piece-master, but also a share of the profit. It has been described as 'co-exploitation' and represented 'a transitional stage in the development of capitalist management' (Hobsbawm, 1964, p. 297, p. 298). Using the textile industry as an exemplar, Daunton (2000, p. 75) explains how the system helped mill owners to maximise profits and, at the same time, avoid strikes:

> On each set of mule spindles, a male adult 'minder' engaged two junior assistants or piecers. The minder was paid according to the output of the machines, so that he had an incentive to run them as quickly and efficiently as possible. He was responsible for disciplining and paying the piecers on a time rate, so he stood to gain from the increased pace of work. The employer could therefore leave labour recruitment and discipline to the minders.

There was of course the possibility of remunerating workers based on time spent in the factory and, although by no means absent from workplace arrangements, suffered from the drawback that close supervision was required to ensure workers did not shirk their duties in terms of the amount of time for which they worked or the extent of their effort when working.

A third possibility was to remunerate individual factory workers, directly, based on completed pieces of work as had been the way of things under the domestic system. Piece-rate remuneration provided an apparent incentive for workers to maximise output and was employed in a manner capable of achieving either 'extensive' or 'intensive' utilization of labour (Hobsbawm, 1964, p. 356). Extensive engagement of labour was the strategy widely adopted by managers in Britain up to at least the middle of the nineteenth century (Hobsbawm, 1964, chapter 17); labour was cheap and in plentiful supply, and management simply increased the number of hours worked or the number of workers employed as and when required. Hobsbawm's authoritative study of 'Labouring men' in Britain produced the conclusion that employers 'neglected the problem of labour management almost completely' because 'few entrepreneurs realized the potential economies of really efficient labour exploitation', instead considering mechanisation a much more important way of improving efficiency and profit (Hobsbawm, 1964, p. 352 and p. 354). Where piece rates were in force, they were usually fixed by custom, as at the New Mills Woollen Manufactory (Walsh & Stewart, 1993, p. 785), and, if management wished to seek an increase in profits by reducing

labour costs, it did so by making employees work longer hours or by cutting the day rate or the piece rate.

The 'intensive utilisation' of the workforce, in contrast, implies implementation by management of explicit strategies designed to deploy human resources more efficiently. This priority may emerge either because labour is in limited supply or because management becomes more highly committed to profit maximisation. The incentive to construct a more productive labour force also increases with the degree of mechanisation so as to minimize overhead costs per unit. It is likely that GMMEs were a more amenable arena for the introduction and operation of disciplinary procedures capable of achieving greater labour intensity than was the business sector in mid-nineteenth century Britain. This was because, as Colonel Arbuthnot put it, 'a government factory can enforce discipline more than a private-one' (BPP 1887 (C.5116), q. 7136, q. 7139). Similarly, Brigadier-General Anderson observed: 'it is most certainly useful for discipline' to have departments headed up by military personnel (BPP 1887 (C.5116), q. 39) because 'a military' man, unlike a civilian, 'is brought up with notions of discipline and authority' (BPP 1887 (C.5116), q. 7134).

The status accorded to discipline is made crystal-clear in employment protocols. For example, Regulation XXVII 'affecting artisans and labourers' of the Royal Carriage Department, entitled 'Discipline', stated: 'Men are to render implicit obedience to the orders of the foremen under whom they are employed. Any act of disobedience or insubordination will lead to the immediate suspension of the offender, and in aggravated cases to his dismissal' (BPP 1887 (C.5116), p. 561). The further away from a military base an armaments factory was located, the greater was the need for discipline and military-type authority: 'There are reasons, I think, why in an outlying place like Enfield, where a large departments is set up in the midst of a civilian population, great good does arise from having a soldier with habits of discipline as the head of the factory' (BPP 1887 (C.5116), q. 3914).

The next two sections describe and analyse the accounting and workplace practices installed at GMMEs between the 1850s and 1880s with the objective of making the workforce more visible and manageable.

5. Expert knowledge-based piece rates

The 1854 fact-finding mission to the United Sates found that, in both government and private gun factories, 'piece-work when applicable is universally preferred to day-work'. Impressed by what they saw, the committee 'respectfully' advised the Board of Ordnance that 'the system of paying by the piece is that on which … the proposed Manufactory of Small Arms [at Enfield Lock], could be best conducted so as to reduce as much as possible, the costs of the arms made, and yet pay good wages to workmen employed' (BPP 1854-1855 (0.11), p. 85). The specific reasons given for making this recommendation were:

- It is then in 'the interest' of the workers 'to turn out as many as possible of the article they work upon'.
- The need for supervision is reduced.
- Workers can be held 'financially responsible for any work they may spoil through carelessness' (BPP 1854-1855 (0.11), p. 85).

Piece rate working had also become the principal method of remunerating the Woolwich Arsenal's work-force by 1856 (BPP 1860 (441), p. 654); see also BPP 1862 (448), p. 186, q. 1576; Hogg, 1963, p. 831), with time-based remuneration restricted in the main to 'foremen, highly skilled mechanics employed in difficult work such as pattern and gauge making, and unskilled labourers mainly employed in transporting stores and articles to and from the shops' (Hogg, 1963, p. 833).

The remainder of this section examines the steps taken to ensure that piece rates were fixed at a level designed to ensure that the public obtained good value for payments made to the GMMEs workforce. This required piece-rate accounting to be transformed from a system designed solely to ensure workers were paid 'customary rates' (Walsh & Stewart, 1993 p. 785) for pieces they happened to complete into a measurement technique that created a calculable person whose achievements were made financially knowable.

5.1. Fixing the piece rate

Although most GMME workers were remunerated by the piece, the day rate remained important both for the purpose of remunerating day workers and, as explained below, to serve as a benchmark for critically analysing payments made to piece workers. War Office staff responsible for compiling a report addressed to the

Under-Secretary of State for War, in 1861, insisted that the overriding 'principle' was that, in fixing the day rate, men's earnings were 'regulated according to the market value of their labour' (BPP 1861 (169), p. 3), i.e. GMMEs paid wages equivalent to the 'usual rates in private manufacturing establishments' (BPP 1861 (169), p. 2).

Fixing the initial piece rate – for example, for the purpose of 'drilling so many holes in a half-inch plate' or 'turning a small spindle 3-inches long' (BPP 1887 (C.5116), q. 1598) – raised the conundrum of goal congruence whereby management aims to keep labour costs per unit to a minimum whereas workers seek to maximise earnings. Major General F. Close, Superintendent of the Royal Carriage Department, explained the pivotal role of the experienced foreman in fixing the piece rate. The foreman was particularly well-equipped to do that job, according to Close, because he 'is constantly in the shop, and … has been there for many years, and understands almost to a nicety what a man *ought* to get out of the work' (BPP 1887 (C.5116), q. 1555, emphasis added; see also q. 1569). Another source of knowledge for the purpose of fixing the initial piece rate was to get 'things done on day-work at first, so as to give [Close] a better idea of what the piece-work price *should be*' (BPP 1887 (C.5116), q. 1602, emphasis added). These arrangements gave rise to a new type of piece rate which, in terms of scientification, fell somewhere between the traditional reliance on custom and practice and the time and motion based norms that were a key feature of the Taylor-led Efficiency Movement of the early twentieth century. The payment norms constructed for use in GMMEs might therefore be described as expert knowledge-based calculations.

It was claimed that the piece-rate system was beneficial to both parties: workers were paid more and the taxpaying public got the job done more cheaply (BPP 1861 (169), p. 3). A 'Memorandum on the Piece-work system in operation in the Royal Carriage Department' (BPP 1887 (C.5116), p. 605, emphasis added) explained how these mutually-beneficial outcomes were achieved:

> The object of piece-work is twofold: - *1st, to ensure a constant and maximum output of work in a given time*, and, 2nd, to do this at no extra cost, less if possible.
>
> Thus, if a man, working on his day rating, do [sic] a piece of work in four hours, the object of piece-work is to encourage him to finish it in three hours, paying him his four hours' rating as the piece-work price. This practically amounts to getting one-third greater output in a given time, and, of course, paying the men one-third more wages than in day-work.

> The advantage to the Service is, a greater output of work for the same expenditure of power, superintendence, &c., and to the workman, increased wages for greater activity.

As the Manager of the RSAF, James McGee, put it: 'the machinery will run at the same rate' whether workers work quickly or slowly (BPP 1887 (C.5116), q. 7707). Therefore, using a system of piece-work remuneration to penalise, financially, workers who failed to produce the target level of output (i.e. one-third above that of the day worker) was intended to economise on overheads and reduced total cost per unit. Behavioural issues were also confronted in an age when workers were making the difficult transition from the irregular and often seasonal rhythms of activity common within the agricultural and domestic spheres to the discipline required for the efficient conduct of factory-based production (Rule, 1986, chapter 5). Expressing the challenge in Foucauldian terms: 'The body now serves as an instrument or intermediary: if one intervenes upon it to imprison it, or to make it work, it is in order to deprive the individual of a liberty that is regarded both as a right and as property' (Foucault, 1991, p. 10). A memorandum on the piece-work system in operation at the Royal Carriage Department focuses on the need, nevertheless, for continuous surveillance of the workforce so as to guard against lax behaviour:

> To secure the full advantage of working piece-work, the workman must be kept constantly in touch with the system, or he will degenerate into performing his work in a mere perfunctory manner; *he must be made to feel that his earnings depend absolutely upon his individual exertions*; that if from any cause he fail to earn his weekly rating he will not get it, or if he earn double he will equally be paid it (BPP 1887 (C.5116), p. 605, emphasis added).

A further challenge to the successful implementation of piece-rate remuneration was the temptation for workers to 'shirk' on quality. Risk of moral hazard was guarded against by making payment conditional on thorough inspection and approval of articles manufactured. According to Superintendent Maitland, each article paid for represented 'equally good work, because it has to be passed by the viewers under a most rigid inspection' (BPP 1887 (C.5116), q. 870).

The day-to-day operation of the piece-rate system at the RSAF, the Royal Carriage Department and the Royal Laboratory, was, technically, a relatively straightforward matter because men were employed individually and 'paid according to the number that they turn out' (BPP 1861 (169), p. 3). The heavy and complex armaments manufactured at the Royal Gun Factory often required workers to operate as teams, thereby

necessitating measurement of the amount of 'labour bestowed' upon a joint task by each member of the fellowship (BPP 1887 (C.5116), q. 5996 and p. 179). The required data was 'ascertained from the muster rolls and returns of attendance, and his proportion of the aggregate amount [i.e. value of articles manufactured] is settled according to the class of workmen to which he belongs in the rating for day-pay' (BPP 1861 (169), p. 3).

The next section reveals that piece rates were continuously monitored and, when revised, usually suffered downward adjustment.

5.2. Monitoring and revising the piece rate

The archives reveal that the performance of workers was the subject of continuous examination to judge whether piece rates required revision. For example, after trialling the initial piece rate for a month to six weeks, it would be reduced where the accounting records revealed that 'the average men possibly are making *considerably over* what their fellows would be making at other jobs in the same shop, all equally good men' (BPP 1887 (C.5116), q. 1531, emphasis added; see also q. 1565). And this might happen because workers had themselves devised more efficient ways of doing things: 'when the workmen find that their earnings depend on their own labour and ingenuity, they discover methods of economising their work … and it is soon found that they earn much more than they would by day-pay' (BPP 1861 (169), p. 3). After early revision, the 'piece-work price' typically remained unchanged for 'a year or two' (BPP 1887 (C.5116), q. 1598, q. 1599), but it was the subject of ongoing review and, for that purpose, the key issue was the level of the premium paid to piece workers compared with the day rate.

The general policy, at the Woolwich Arsenal, was that the piece rate should be set at a level which enabled 'an ordinary fair average' piece worker to earn around one-third more than the day rate (BPP 1887 (C.5116) q. 1532; see also qq. 5335-5337), but a 'superior workman would make more than that' and an 'indifferent workman would make less than one third' (BPP 1887 (C.5116), q. 1532). One third was not an invariable rule in time or place. At the Royal Gun Factory, in 1861, the expected premium was put at one-quarter whereas, in 1887, something between three-eighths and one-half was considered a reasonable benchmark (BPP 1861 (169), p. 3; BPP 1887 (C.5116), qq. 531-532, q. 6415). These differences, although not part of a scientific norm-based methodology, were not entirely arbitrary in character. Time and a half was paid at the

Gun Factory in 1887 because it was 'more arduous and more dangerous work, and they [the workers] expect more' (BPP 1887 (C.5116), q. 875).

The amount earned by individual workers would naturally depend on speed of performance, and the challenge was to decide whether, and when, an adjustment to the piece rate was appropriate. Personnel at different levels within the managerial structure were explicitly charged with this responsibility. In the Royal Carriage Department, for example, the Assistant Superintendent, Major Ormsby, undertook 'The weekly examination of the men's piece-work earnings, to remove any errors of excess or defect in the pricing of the various operations as they may become apparent' (BPP 1887 (C.5116), p. 556). This duty of surveillance reached down through the managerial structure with, at shop floor level, the foreman responsible for checking whether piece workers' weekly earnings broadly represented a premium of one-third over the day rate. Charles D. Piper, principal clerk in the Royal Carriage Department, stated that if, for example, piece-workers earned £3 when they were 'rated' for 35s the foreman would make an enquiry to find out how this might have happened (BPP 1887 (C.5116), qq. 5387-5388). £3 compared with 35s. represented an exceptional premium, however, and modest increments were not the subject of investigation unless the worker was 'constantly earning more than the standard rate' (BPP 1887 (C.5116), q. 5390).

Although the successful exercise of disciplinary power is designed to create 'docile bodies' (Foucault, 1991, pp. 135-169), this is not a state of affairs easily reached, and the fixing and revision of piece rates was an arena within which GMME workers sought to exert influence. Disciplining the labour force in a Foucauldian sense is, of course, a completely different process from the 'vengeance of an outraged law' central to the exercise of sovereign power (Foucault, 1991, p. 179). The desired outcome is instead obtained 'through the mechanics of training' whereby: 'Discipline "makes" individuals; it is the specific technique of a power that regards individuals both as objects and as instruments of its exercise' (Foucault, 1991, p. 170 and p. 179). To get the best out of the GMME workforce, a memorandum designed to help make effective piece-rate working at the Royal Carriage Department acknowledged the importance of the system's acceptability to both master and servant: 'The working of the system should be such as to establish a mutual confidence, the workman feeling that strict justice alone influences the cutting down or raising of prices, and the master being assured that no combinations of men exist to keep prices too high' (BPP 1887 (C.5116), p. 606). It is

uncertain that management/worker relationships were, however, always as harmonious as this assessment implies.

It is certainly the case that lack of goal congruence led to 'game-playing' by each faction, both when the initial rate was fixed and thereafter. At 'the commencement of a new piece-work job', according to Superintendent Close, management had to guard against the 'great inducement to the men to turn out a smaller quantity … so that the price for that article may be fixed at rather a higher rate' (BPP 1887 (C.5116), q. 1552), i.e. the workers had begun, as Hobsbawm (1964, p. 361) put it, to understand 'the rules of the game'. Then, during the life-span of the piece rate, the knowledge that the price would be reduced if earnings were deemed by management to be too high caused 'some of the men always, so to speak, keep a little [output] up their sleeve' (BPP 1887 (C.5116), q. 873; see also q. 531). An administrative circular warned management to suspect collusion where 'the earnings be uniform in any shop for many weeks in succession', in which case the recommended remedy was 'at once [to] reduce the prices until the men are compelled to work upon their merits, which will be shown by some drawing higher wages than others' (BPP 1887 (C.5116), p. 606). Turning to the Royal Gun Factory, one of its foremen, Richard Edmonds, agreed that 'it is very rarely that they go over' the conventional premium

> because they know that we are *watching* and looking after them; we do not say, 'You must not earn any more,' but they seem to think this – 'If we do earn something more, we shall probably have our prices taken down' (BPP 1887 (C.5116), q. 6415, emphasis added).

Superintendent Maitland, summed up the situation as follows: 'they [the workers] know very well that after a time the piece work price would be reduced. It is a constant match between the Foreman to reduce the prices and those men to prevent their being reduced' (BPP 1887 (C.5116), q. 532). In the opinion of Superintendent Close, 'inasmuch as the price is always subject to revision they [the workers] do not benefit in the long run' (BPP 1887 (C.5116), q. 1552). Management freely admitted that 'revisions are mostly in the direction of lowering the prices' but this was attributed to the fact that the initial price was often set high to ensure workers receive a fair remuneration while they got used to a new 'pattern' (BPP 1887 (C.5116), p. 606). Only exceptionally, it seems, would the piece rate be increased as the result of the review process (BPP 1887 (C.5116), q. 1532, q. 1568; Pam, 1998, p. 103).

The accounting procedures employed 'to codify, regulate and normalise behaviours' (Fúnez, 2005, p. 91) are next examined.

6. Depicting human selves in written form

The purpose of new ways of accounting introduced at GMMEs from the 1850s onwards was to treat the worker as a 'fragment of mobile space' who could be submitted to various disciplines to maximise his utility in terms of production efficiency (Foucault, 1991, p. 164). It will be shown that the GMMEs factory accounts reveal much more than payments made to operatives. In addition the accounting records interrogate performance: 'By assigning individual operators to a specific space or place, and by accounting for the performance of each operator, a much tighter control over performance can be effected' (Carmona et al., 2002, p. 243).

Evidence presented to the Committee Appointed to Inquire into the Organization and Administration of the Manufacturing Departments of the Army – the Morley Committee – illuminates the arrangements put in place to enable management to monitor, remunerate and discipline the workforce. The starting point for imposing effective jurisdiction was the attendance records. These were designed to measure the amounts payable to day workers which, as discussed above, provided a benchmark for reviewing and revising the piece rate. Time records also fulfilled a key disciplinary role by encouraging the regularity of attendance required to achieve efficient factory-based production. For this reason, the piece worker, according to the Principal Clerk at the Royal Laboratory, was obliged to 'keep time as regularly as a day work man' (BPP 1887 (C.5116), q. 5641, q. 5642). Failure to comply with this requirement resulted in the imposition of fines for late or non-attendance (BPP 1887 (C.5116), q. 5659). Rules and regulations setting out the duties and responsibilities of gun factory workers ran to 56 paragraphs and covered a miscellany of issues relating to attendance, rates of pay, overtime (for day workers), sickness, injuries, leave of absence and holidays (BPP 1887 (C.5116), Appendix IX, pp. 533-53). This required an extensive system of individualised record-keeping in the endeavour to construct a more governable worker.

Hours of work at the Royal Gun Factory, for example, were specified as follows for Monday through to Thursday: 6am-8am, 9am-1pm and 2pm-5.30pm. Day shifts on Friday amounted to 10 hours and on Saturday to six hours, adding up to the working week of 54 hours. The night shift Monday-Friday ran from 5.20pm to 6am, with

continuity of production guaranteed by the requirement that 'men on night-shift [be] not allowed to leave work until those who are to take their places for the next shift have arrived' (BPP 1887 (C.5116), p. 533). Compliance with these regulations was measured by a prominently displayed time-piece which, as at the Royal Tobacco Factory, served to help fulfil 'disciplinary purposes' (Carmona et al., 2002, p. 243): 'The clock at the ticket office regulates the general attendance. No one is to leave his work until the bell rings' (BPP 1887 (C.5116), p. 533).

Within this temporal structure a system of ticketing was employed to substantiate attendance at the workplace. On arrival at the factory the workman deposited a metal docket bearing his identity number in the ticket box. Failure to do so resulted in non-recognition of attendance for wage payment purposes. To accommodate the possibility of a number of workmen queuing to deposit their metal tickets, a rather less than generous 'one minute's grace' was allowed (BPP 1887 (C.5116), p. 534). Night workers were admitted to the factory provided they arrived no later than '10 minutes after the proper time', but would lose one hour's pay. Anyone depositing the ticket of another worker risked immediate dismissal.

The system of managerial authority and worker subservience is also clarified:

> Workmen are to render implicit and unhesitating obedience to the orders of the foreman or others under whom they are employed. They are also to obey the orders of the warder. Any act of disobedience or insubordination will lead to the immediate suspension of the offender and, in aggravated cases, to his dismissal (BPP 1887 (C.5116), p. 534).

Turning to the extensive accounting arrangements required to operate the system of piece-rate remuneration which was used as a basis for exercising disciplinary power the practices described below focus principally on the Royal Gun Factory where, as noted above, fellowship working was the more common practice. The procedures employed are explained drawing mainly on evidence presented by Superintendent Maitland, the rules and regulations set out in Appendix VIII of the Morley Committee's report, and the 70 *pro forma* accounts and forms reproduced as Appendix IX (BPP 1887 (C.5116), q. 601 and pp. 535-551).[14] These data reveal major concerns with accountability and

[14] The existence of corresponding arrangements in other military establishments is indicated by material for the Royal Carriage Department reproduced as: Appendix XIII – Division of duties; Appendix XIV – Regulations affecting artisans and labourers; Appendix XV – Extracts from departmental orders; Appendix XVI – Outline of the system of accounts (BPP 1887 (C.5116), pp. 556-568).

control in terms of a determination to ensure payments were made only for goods and services actually rendered to the Royal Gun Factory, that the output of each individual worker was made clearly visible and that the cost of each product was accurately computed. The bare bones of the administrative arrangements put in place for these purposes are summarised in the remainder of this section.

Work mandates received by the Royal Gun Factory from the War Office were given an order number and then forwarded to a manager who allocated the job to the foreman responsible for its completion. A record of time spent by day workers on each order/job was kept by a work-taker and recorded in his account book which was also signed by the chief foreman. The build-up of wages paid to a group of day workers in the Steam Branch for the week ended 28 November 1885 is reproduced as Fig. 3. It reports, for each of them, the hours spent on individual jobs (Gawion and Capon worked during the week on the same job – order no. 1014), the rate per hour, and the total labour cost.

Turning to the accounting arrangements made for remunerating workers by the piece, the 'Piece Work Account' (Fig. 4) records the name and number of each worker and the amount payable for the week ended 16 January 1886.[15] It also shows the number of hours worked which, when multiplied by the hourly rate, gives the amount a worker would have received if remunerated on the day-rate basis.[16] This information therefore enabled management to assess whether the premium earned was acceptable or whether a reduction in the piece rate required consideration. The way in which this might be done is described by the Royal Laboratory's Principal Clerk, W.E.S. Oram: 'Every week we get a statement from one shop or another giving the amount of the wages earned by piecework, and the wages which the same men would earn by daywork, and we are then able to see that the piecework wages are not in excess; … we think that a very good check' (BPP 1887 (C.5116), q. 5641).

The work-takers were also responsible for accurately logging completed pieces of work. Piece Work Vouchers (Fig. 5) were used to record work done on a particular

[15] The Piece Work Account was signed by the chief foreman and sent to the wages branch where it was 'compared with the total of the piece-work vouchers presented for payment on account of work done' (BPP 1887 (C.5116), p. 94).

[16] Dallen actually worked 62 hours but, if remunerated on the time basis, this equated to 69 hours due, perhaps, to a premium payable for working outside normal hours. Thus Dallen's remuneration on the day-rate basis would have amounted to 69 hours x 8*d*. = £2 6*s*. 0*d*.

order, such as that on order numbers 9, 13 and 14 during the week ended 28 November 1885 (Fig. 5, EE). The piece-rate vouchers were signed by the Work-taker (J. Hills), the Examiner (H.R.), who confirmed that work was up to the required standard, and, as in the case of the Piece Work Account, the Chief Foreman (J. W. Loveridge).

The Examiner played a key role in infusing discipline within the labour force, with his responsibilities explained more fully in evidence detailing the piece-work practices in the Royal Carriage Department. According to Superintendent Close, the department employed a Chief Examiner and 36 Examiners, 'all of whom are experienced artizans in the timber and iron trades' (BPP 1887 (C.5116), q. 1442). These examiners based their assessment of the quality of work completed on both observation and physical measurement, with the need for great accuracy driven by the requirement for carriage components to be fully interchangeable:

> As we have at the present time very complicated machines for the movement of the heaviest guns as well as the lightest, extremely good engine-fitting work is required, and therefore the difficulty of securing the interchangeability of parts is greatly enhanced. As a matter of fact our ordinary workmen work to the 1/000th of an inch. That is the working limit (BPP 1887 (C.5116), q. 1464).

Examiners were provided with gauges to enable them to check whether the required parameters were met, and their 'sense of responsibility' was 'sharpened by the necessity of stamping with their identifying mark all work passed by them' (BPP 1887 (C.5116), q. 1442). Application of the stamp therefore supplied the audit trail linking the examiner with each completed piece of work. Where the level of rejections was of a 'serious nature' the offending workman was reported to the superintendent to decide what disciplinary action was required (BPP 1887 (C.5116), q. 1442). For minor offences, the Assistant Superintendent had the power to fix the penalty, e.g. suspension.

Returning to the Royal Gun Factory, the data recorded on piece-work vouchers were summarised in a 'Piecework Account' (Fig. 5, FF) after checking that the rates shown on the vouchers were in line with the prices authorised for that particular type of work. Using the above primary documentation, the amounts earned by day workers and piece workers each week were then recorded in the wages summary which revealed the amounts paid in respect of each job to workers in the various departments of the Royal Gun Factory (Fig. 6). It can be seen that the amount paid under order no. 13 (£1 17s. 6d. from Fig. 5) for work in the Field Gun Section (F.G.S) appears in column 2. Wages paid to both day and piece workers were then summarised, for each month and each job, in a

Wages Abstract and, from there, transferred to the relevant account in the cost ledger. This double entry-based ledger account showing the accumulated cost of a 'B[reech]. L[oading]., 4-Inch, 22 cwt.' gun, including also material and indirect costs, is reproduced as Fig. 7.

The history presented above reveals no evidence of the use by GMMEs of scientifically established labour standards based on time-and-motion studies as was the case at the US Springfield Armory and which became a key feature of the scientific management era in Britain in the early twentieth century. However, it does disclose the existence of workplace practices designed to make the workforce visible and manageable by: (a) analysing manufacturing processes into their constituent elements; (b) paying for work by the piece based on the conviction that this method of worker remuneration best achieved labour efficiency; (c) fixing the piece rate by drawing on expert knowledge of achievable output; (d) continuously reviewed the validity of the piece rate in two different ways – first by comparisons with the day rate; second through benchmarking rates paid in the private sector; and (e) operating a detailed system of record keeping to ensure accurate records of attendance and of day-rate and piece-rate remuneration. The examination of performance therefore entailed a 'whole apparatus of writing' to supply the 'disciplinary methods' that created a 'describable individuality [of each GMME worker] and made of this description a means of control and a method of domination' (Foucault, 1991, p. 190, p. 191).

Underpinning these arrangements are ideas central to Foucault's (1991, p. 177, p. 180) concept of 'gratification-punishment', where the purpose of that 'double system' is to serve as a corrective device. At Britain's GMMEs, piece rate arrangements functioned as an everyday apparatus designed to fulfil that dual role. The dedicated piece rate worker was rewarded for producing more items than would have been the case if remunerated on the time basis whereas the lazy or inefficient worker suffered punishment through lower wages. The assumption was that GMME workers would be expected to cooperate in their own subjection as they would believe, based on observation of how they and their colleagues were treated, that working harder was the best course of action for them to follow, i.e. they would become 'docile bodies' that functioned as their own disciplinarian (see Foucault, 1991, chapter 2).

We saw in section 5 that the desire for 'fair' treatment of the workforce featured prominently in the rhetoric surrounding the discussion of day rates and piece rates, and

this might well have been a genuine concern. In the absence of corroborating testimony provided by 'voices from below' (Napier, 2006, p. 459), however, it is probably wise to retain a degree of suspicion that GMME's managers aimed to impose minimum, rather than fair, rates of remuneration on the workforce. Consistent with this idea, the next section reveals incontrovertible evidence that the pursuit of productive efficiency sometimes had serious negative consequences for the economic and social conditions of workers and their families.

7. Cost-cutting, efficiency and economy

In a House of Commons debate during the Spring of 1893 the Secretary of State for War, Henry Campbell-Bannerman, insisted that 'the Government should show themselves to be amongst the best employers of the country, that they should be, if I may use the phrase, in the first flight of employers' (Hansard, 6 March 1893, vol. 9, col. 1129). But Campbell-Bannerman did not intend to imply that the government should not aim to get value for money. While acknowledging the fact that, unlike the private sector, 'we are not bound to make a profit', he insisted that the government was 'subject to another influence and consideration, I may well say, to take the place of eagerness to make a profit', namely 'that we are dealing – not with our own money, but with other people's [the taxpayers'] money' (Hansard, 6 March 1893, vol. 9, col. 1130).

The evidence presented in this paper reveals that, as the century progressed, the affairs of GMMEs witnessed a growing emphasis on the pursuit of the entrepreneurial ideal of 'cheap and efficient government' (Perkin, 1969, p. 320; see also p. 379) with, at the end-date of this study, the terms of reference given to the Morley Committee making it clear that 'the inquiry should be limited to the question whether any, and what, improvements can be suggested, with a view to greater efficiency and economy' (BPP 1887 (C.5116), p. iii). GMMEs strove, from the 1850s onwards, to gain a firm control over costs in the endeavour to legitimise their role as least-cost suppliers of military weapons, and the widespread adoption of piece-rate remuneration contributed to this objective. Piece working also avoided burdening the department with a 'fixed establishment of workmen' for which it had no remunerative work (BPP 1861 (169) p. 3): workers were summarily sacked when no longer required (BPP 1861 (169) p. 3). There are other examples of ways in which management's determination to drive down manufacturing costs increased the financial pressure on workers and their families.

Changes in manufacturing methods sometimes had major economic and social implications for the workforce. In July 1855, for example, notice was served on all existing employees at the RSAF because the 'skill and experience required for hand processes had been much reduced' by the introduction of the assembly-line production techniques (Pam, 1998, pp. 56-57). Some were re-engaged 'on altered terms' but, of the others, only those with 'long and faithful service' were awarded gratuities (Pam, 1998, p. 57). In 1871 the decision was taken to manufacture the Martini Henry rifle. Little work was available during the ensuing 'upheaval', with the men 'unable to earn more than a few shillings a week' and, in some cases, 'forced to run up crippling debts in local shops' (Pam, 1998, p. 74, p. 75). Two years later, men were discharged and pensioned off in large numbers as the result of further mechanisation of weapon-making facilities (Pam, 1998, p. 80; see also p. 94, p. 95 and pp. 100-101).

The effect on the piece rate of increased mechanisation and consequential deskilling of the labour force is the subject of a series of reports prepared for the Director of Artillery by the Superintendent of the RSAF. The piece rates paid to workers engaged to manufacture the Martini Henry rifle during each of the six years from 1871-1872 to 1876-1877 are set out in Table 2.

Table 2
Piece rates Martini Henry rifle (National Archives).

Year	Piece rate		
	£	*s.*	*d.*
1871-1872	1	13	7
1872-1873	1	8	9
1873-1874	1	3	3
1874-1875		18	9¼
1875-1876		16	0½
1876-1877		14	4

The reduction in the piece rate of 4*s*. 10*d*. (14.4%) in 1872-1873 was achieved because management 'substituted finishing machines for hand labour, thereby obtaining greater rapidity of production'. The further fall in the piece rate to £1 3*s*. 3*d*. in 1873-1874 was attributed to the use, in the finishing process, 'of machines and unskilled cheap labour, in the room of hand-work and high wages'. The much greater precision resulting from additional mechanisation meant that most of the rifles could 'now be assembled from the machines without other manual labour or adjustment than that required to simply put the parts together'. Further planned changes to production methods were intended to enable management to reduce costs by dispensing 'with the

services of highly paid men for good and all', and Table 2 reveals that these expectations were fulfilled. By 1876-1877 the piece rate was less than half the level of just five years earlier.[17]

The workforce also suffered hardship when threats of war receded. The RSAF was a source of 'full and steady employment' for the ten years following the ending of the Crimean War (1854-1856), but was then run down with employees encouraged to leave through, for example, the offer of free passage to Canada (Pam, 1998, p. 74). Another reduction in manufacturing activity, in 1876, caused a large number of artisans and labourers to be discharged. Even where gratuities were awarded, these were often lower than expected because of swingeing deductions made for time lost due to no fault on the part of the worker, e.g. because men were temporarily laid off to enable greater mechanisation of the production process or were absent due to sickness (Pam, 1998, p. 81). In one case, an employee who had been unwell for three weeks was penalised a year's service (*Gazette* 13 May, 1876, quoted in Pam, 1998, p. 81).

8. Discussion and concluding remarks

A number of different methods have been used, through the ages, to remunerate Britain's workers. Time-based payments have been a feature throughout, with direct supervision relied upon to help maximise worker productivity where that was a priority. Payment by the piece was a natural and convenient method of remuneration under the domestic system and one also used when workers assembled to undertake factory-based production. The history of labour arrangements indicates, initially, no major concern to ensure maximum productivity, with personnel reimbursed for the number of pieces they happened to complete and the amount paid based on custom and practice. As management became more interested in maximising productivity, e.g. to make better use of expensive capital equipment, steps were taken to achieve intensive as opposed to extensive utilisation of the labour force. In this transition, the construction of piece rates which measured more precisely the amount paid to workers played a key role. The rise of scientific management 'at the turn of the [nineteenth] century … attempted to [further] increase the efficiency of workers by determining and setting work standards for as many aspects of the worker's task as possible' based on

[17] It should be noted that the Rousseaux overall price indices for 1800-1913 to have fallen from 128 to 110 between 1872 and 1877 (Mitchell, 1988, p. 723).

time and motion studies (Young & Davis, 1990, p. 89). Against this background, the present paper broadens our understanding of the history of ways of managing and remunerating the workforce by studying arrangements put in place at a site largely overlooked by accounting historians, i.e. the GMMEs of Victorian Britain.

The historical evidence presented in this study reveals that workplace practices fashioned by GMME managers were designed to supply a new mode of discipline, theorised by Foucault (1991), through surveillance, correction, and training within an enclosed factory space. The precise steps taken to improve the visibility of the GMMEs workforce was both architectural and documentary. The RSAF imported to Britain the 'American system of manufacturing' in the late 1850s, and this involved, for the first time, the operation of the assembly-line technique with jobs broken down into their constituent parts. The construction and design of the RSAF's machine shop (Fig. 1) was intended to improve management surveillance of employees going about their new work, but it is the use of new ways of record keeping to measure the 'activity of the men, their skill, the way they set about their tasks, their promptness, their zeal, their behaviour' (Foucault, 1991, p. 174) which is the main focus of this paper.

Management's preoccupation with economy and efficiency was stressed time and again in evidence presented to the Morley Committee, with actions taken to impose rigorous labour practices on the GMME workforce summarised as follows by the Superintendent of the Royal Gunpowder Factory (BPP 1887 (C.5116), q. 7093):

> Great care in selection of suitable workmen as regards age, intelligence, and stamina. Judicious weeding out of the inefficient and retention of only thoroughly capable and trustworthy hands. … Care in so adapting the manual labour to the producing power of the machinery, that the out-turn may be a maximum. This is attained by a judicious arrangement of the working hours.

These priorities were partly achieved through the operation of a system of record keeping which went beyond tracking rights and obligations so as to measure, discipline and transform behaviour within the workplace. For example, the 'documentary techniques' put in place to record attendance supplied the power-knowledge required to objectify and dominate workers through a system of penalties designed to fulfil an 'essentially corrective' role (Foucault, 1991, p. 179, p. 191). In a similar vein, the expert knowledge-based piece rates supplied the 'penal accountancy' required to construct 'the punitive balance-sheet of each individual' and, thereby, the level of financial reward (Foucault, 1991, p. 180). In these and other ways the disciplinary power provided by hierarchical observation through accounting records made GMME workers 'clearly visible' so that that they could be known and altered (Foucault, 1991, p. 171)

We have uncovered no evidence to suggest that piece rates were based on scientific, norm-based, time and motion studies nor, therefore, that performance was measured in terms of deviations from scientifically computed norms as became the practice during the scientific management era. On the other hand, when fixing the piece rate in GMMEs, management was not the passive acceptance of traditional tariffs which was the hallmark of earlier workplace practices. Instead, in the words of Superintendent General F. Close, piece rates were based on what an experienced foreman believed 'a man *ought* to get out of the work' (BPP 1887 (C.5116), q. 1555, emphasis added). We therefore conclude that serious efforts were made to set rates at a level designed to achieve effective control over labour costs and, thereby to help construct an embryonic 'governable worker'. To achieve this objective, this study has revealed the existence of:

1. detailed regulations designed to ensure that workers understood their employment obligations, which included the duty to attend the factory during specified time periods and to obey, without question, orders from their superiors;
2. a system of time records capable of tracking, accurately, attendance at the workplace with significant penalties imposed for failure to comply with this disciplinary obligation;
3. a scheme of accounting which went beyond a record of physical flows to express the value of work done, in financial terms, that could be compared with the expected output of a day worker.

The GMME system of expert knowledge-based piece-rates, like standard costing some decades later, therefore 'made possible a new form of government of persons within the firm' (Miller & O'Leary, 1994, p. 99) and should be viewed as a 'technology' designed to fashion 'individuals, entities and activities in conformity with a particular set of ideals' (Miller & O'Leary, 1994, p. 99) which, for successive governments in nineteenth-century Britain, was improved efficiency and economy. The objective was, therefore, the construction of a system of authority and dominance capable of ensuring maximum output. But this did not produce a situation where workers were entirely subjugated to the willpower of management, and it unlikely that the workforce, then or much later, was ever reduced to entirely robotic behaviour. When setting piece rates at GMMEs, the 'rules of the game' (Hobsbawm, 1964, p. 361) saw workers engage in game-playing designed to maximise the price paid and management doing its best to counter such tactics.

The findings presented in this paper support the case for accounting historians extending their study of the available archives to achieve a richer and deeper understanding of the constitutive role played by accounting in the quest, through time, for management control over labour. The present paper contributes to that endeavour by showing how managers at Britain's GMMEs – a site neglected by accounting historians – devised a scheme of human accountability which, as in the case of standard costing some years later, involved 'the elaboration of a range of techniques for the supervision, administration and disciplining of a population of human individuals' (Miller & O'Leary, 1987, p. 239).

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Fig. 1. Royal Small Arms Factory machine shop (Matthews, 2000). Copyright on this image is owned by Christine Matthews and is licensed for reuse under the Creative Commons Attribution-ShareAlike 2.0 license.

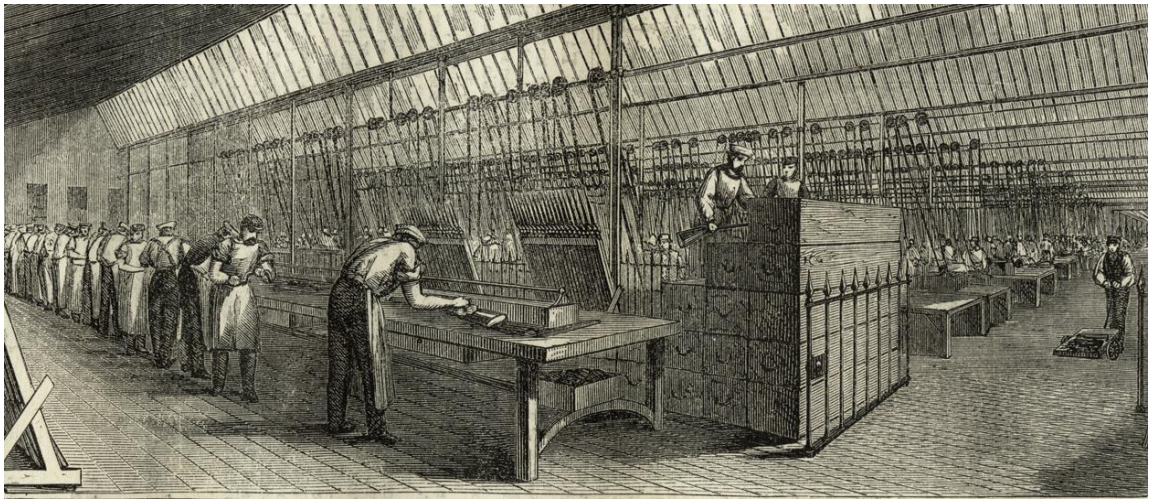

Fig. 2. 'Large room' at the royal small arms factory in 1861 (*Illustrated London News*, 1861, p. 298).

WORK TAKER'S BOOK.

Steam Branch.—Week ending November 28th, 1886.

Description of Work.	Order.	Monday.	Tuesday.	Wednesday.	Thursday.	Friday.	Saturday.	Total Hours.	Rates.	Amount.		
										£	s.	d.
724. *Lyle.*									d.			
Making patterns for shafting.	1034	11 / 7½	9½	9½	9½	4	a	51½	9	1	18	7½
Holiday	1025					4		4	„	-	3	-
								55½	„	2	1	7½
731. *Ball.*									d.			
Removing electric light machine.	1006	9½	8½	7½	9½	6	6	48	8⅔	1	15	6½
Holiday	1025					4		4	„	-	2	11½
								52	„	1	18	6
743. *Glover.*									d.			
Extension of S. B. M. columns.	1686	16 / 9½	7½	9½	9½	6	6	71	8⅓	2	9	3½
Holiday	1025					4		4	„	-	2	9½
								75	„	2	12	1
754. *Rogers.*									d.			
Repairs to boilers	1011	7½ / 9½	9½					30	8	1	-	-
Do. oil tank	1083			6 / 9½	9½	6	6	40	„	1	6	8
Holiday	1025					4		4	„	-	2	8
								74	„	2	9	4
848. *Gawion.*									d.			
Turning engine fittings	1014	11 / 9½	7½	9½	7½	4	6	57½	6⅔	1	9	9½
Holiday	1025					4		4	„	-	2	1
								61½	„	1	11	10½
1150. *Gardiner.*									d.			
Stoking boilers	1012	4 / 9½	9½					25	4⅔	-	8	9½
Do. departure locomotive.	991			17½ / 9½	9½	6	6	57	„	1	-	½
Holiday	1025					4		4	„	-	1	5
								86	„	1	10	3
1169. *Capon.*									d.			
Repairs to boilers	1014	9½	9½	9½	9½			38	3⅓	-	9	10
Do. oil tank	1083					6	6	12	„	-	3	1½
Holiday	1025					4		4	„	-	1	½
								54	„	-	14	-

N. S. CRAUFORD, Worktaker. (Sd.) J. RONALD, Chief Foreman.

Abstract				
	d.	£	s.	d.
55½	9	2	1	7½
52	8⅔	1	18	6
75	8⅔	2	12	1
74	8	2	9	4
61½	6⅔	1	11	10½
86	4⅔	1	10	3
54	3⅓	-	14	-
	£	12	17	8

Fig. 3. Work-taker's book (BPP 1887 (C.5116), p. 541).

PIECE WORK ACCOUNT.
For week ending 16th January 1886.

No.	Names.	Designation.	Amount. £	s.	d.	Remarks.	Actual Hours.	Hours.	Rate.	Amount. £	s.	d.
11	Fuller -		2	5	10		50		8	1	13	4
12	Harvey -		2	9	6		54		8	1	16	-
14	Dallen -		3	2	-		62	69	8	2	6	-

Fig. 4. Piece work account (BPP 1887 (C.5116), p. 550).

E E.

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No. 41. Royal Gun Factories, 28.11.1885.

Worktaker,
Please to receive the following stores:—

ORDER No. 9. GUN 6", III.

Slotting and fitting interruptions to thread for breech screw - 1 @ 85/-
Fitting C⁵ Hoop complete for carrier ring with studs slide masking 1 @ 115/-

(Sd.) H. R., $30\frac{11}{85}$, (Examiner).
(Sd.) J. W. LOVERIDGE, Chief Foreman.
(Sd.) J. HILLS, Worktaker.

E E.

E³.

No. 19. Royal Gun Factories, 28.11.1885.

Worktaker,
Please to receive the following stores:—

ORDER No. 13. GUN 4", IV.

Rough boring "A." Tube - 1 @ 37/6

(Sd.) H. R., $30\frac{11}{85}$, (Examiner).
(Sd.) J. W. LOVERIDGE, Chief Foreman.
(Sd.) J. HILLS, Worktaker.

E E.

E³.

No. 17. Royal Gun Factories, 28.11.85.

Worktaker,
Please to receive the following stores:—

ORDER No. 14. GUN 5", III.

Steel Jacket:
Rough turning arms of trunnions, 8936, 8974, 9032, 9159, 8997, 9042, 9031 - - - 7 @ 17/-
Finish turning arms of trunnions, 8682 - - - 1 @ 17/-
Slotting and fitting interruptions to thread for breech screw - 1 @ 63/-
Fitting D Hoop complete for carrier ring - - - 1 @ 140/-
Rough turning and boring "D" Hoop - - - 5 @ 11/-
Finish turning and boring "D" Hoop - - - 5 @ 32/-

(Sd.) H. R., $30\frac{11}{85}$, (Examiners.)
(Sd.) J. W. LOVERIDGE, Chief Foreman.
(Sd.) J. HILLS, Worktaker.

F F.

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PIECEWORK ACCOUNT. FIELD GUN SECTION, LOWER.
For the Week ending 28th Nov. 1885.

Order.	Description of Work.	No.	Price.	Amount.			Total.		
9	Slotting and fitting interruptions to thread for breech screw - -	1	85/-	4	5	-			
	Fitting C 5 Hoop complete for carrier ring, with stud slide masking -	1	115/-	5	15	-	10	-	-
13	Rough boring "A" tube - - -	1	37/6	-	-	-	1	17	6
14	Rough turning arms of trunnions -	7	17/-	5	19	-			
	Finish " " " -	1	17/-	-	17	-			
	Slotting and fitting interruptions to thread for breech screw - -	1	63/-	3	3	-			
	Fitting "D" Hoop complete for carrier ring - - - -	1	140/-	7	-	-			
	Rough turning and boring "D" Hoop -	5	11/-	2	15	-			
	Finish " " " -	5	32/-	8	-	-	27	14	-

Fig. 5. Piecework records (BPP 1887 (C.5116), p. 542).

SUMMARY OF WAGES. WEEK ENDING NOVEMBER 28, 1885.

No. of Order.	F. G. S.			Miscellaneous.			Forges.			Sighting Room, &c.			D. S.			Writers, &c.			N. P.			Total.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1										24	4	-										24	4	-
7				11	9	4½																11	9	4½
9	10	-	-	1	4	3				2	17	-										14	1	3
11										13	1	-	-	7	½				-	-	10½	13	8	11
13	1	17	6	2	13	6	1	3	4	3	16	-										9	10	4
14	27	14	-				-	15	-	55	14	1										84	3	1
16	67	1	-	1	1	3				1	19	9½	3	16	-				-	9	8	74	7	8½
17										20	-	-	-	5	1	-	6	9½	-	-	7½	20	12	6
18				-	5	-				1	8	9										1	13	9
20	24	15	6							3	14	7										28	10	1
22				3	19	9	2	5	-	93	9	6										99	14	3

Fig. 6. Summary of wages (BPP 1887 (C.5116), p. 543).

ORDER 16.

DR. MANUFACTURING ORDNANCE, B.L., 4-INCH, 22 CWT. CR.

Date.	Folio.		Material.			Labour.			Indirect Expenditure.			Total.			Date.	Number.		Material.			Labour.			Indirect Expenditure.			Total.		
1883. April		Semi-manufacture.	600	-	-	750	-	-	307	1	2					6	To C. G.	636	-	11	802	19	9½	327	19	-			
"						8	12	0																					
May						-	11	4																					
June						-	6	4																					
July						2	10	6																					
Aug.						-	7	6																					
Sept.			5	9	6	-	14	5																					
Oct.						-	19	8																					
Decr.						1	5	3½																					
1884. Febry.						1	19	-																					
		Special percentage.	1	6	10	10	9	9																					
		From 1,265 -	17	4	7																								
		" 43, Tools, &c.	12	-	-	25	4	-	9	18	9																		
		" 1.031 -							10	19	1																		
			636	-	11	802	19	9½	327	19	-							636	-	11	802	19	9½	327	19	-			

Fig. 7. Extract from cost ledger (BPP 1887 (C.5116), p. 542).